

A New African Species of Aedes  
(Diptera: Culicidae)<sup>1</sup>

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**ABSTRACT.** A new species, Aedes (Neomelaniconion) mcintoshii, is described and illustrated. Diagnostic characters for separating the adults of mcintoshii from closely allied species are given. The distribution of mcintoshii is based on examined specimens. In addition, detailed descriptions and illustrations of the female wing and the male genitalia of Aedes (Neomelaniconion) lineatopennis from the Philippines are also given.

#### INTRODUCTION

Although specimens determined as Aedes lineatopennis (Ludlow) have been incriminated as vectors of Rift Valley Fever (RVF) in Africa (McIntosh 1972, in Zimbabwe; Davies and Highton 1980, in Kenya; and McIntosh et al. 1980, in South Africa), no one has clearly demonstrated that this species occurs there. Ludlow (1905:133) originally described this species from specimens collected in Luzon, Philippines, but Edwards (1915:274) subsequently considered Ae. lineatopennis to be widespread in both the Oriental and Afrotropical regions. Still later, Edwards (1941) and McIntosh (1971) again considered African specimens to be conspecific with the type from the Philippines, and since then, the name lineatopennis has been generally applied to this species in Africa.

In view of present-day interest and research on Rift Valley Fever in Africa, it is desirable to clarify the taxonomic status of the mosquito vector from that region. Specifically, this study responds to requests for identification assistance in support of ongoing studies on Rift Valley Fever. This paper reports on the descriptive details and the taxonomic status of a species currently recognized as a primary enzootic vector of RVF in Africa.

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Based on a detailed morphological study of pertinent specimens, it is now apparent that the so-called "lineatopennis" from Africa is not conspecific with specimens from the Philippines, the provenance of the lectotype of Ae. lineatopennis. To the contrary, my study indicates that the African populations represent a new species of Aedes in the subgenus Neomelaniconion Newstead. The new species, Ae. mcintoshii, is indeed remarkably similar to Ae. lineatopennis and, as noted, has frequently been misidentified as that species. In addition to the description of Ae. mcintoshii, detailed descriptions and illustrations of the female wing and the male genitalia of Ae. lineatopennis from the Philippines are also provided.

#### MATERIALS AND METHODS

This study is based on specimens that were collected or otherwise acquired by the Medical Entomology Project (MEP) and the Systematics of Aedes Mosquitoes Project (SAMP), and the Walter Reed Biosystematics Unit (WRBU), National Museum of Natural History, Smithsonian Institution (USNM). Distribution records are listed in the following order and format: Country names are in capital letters, administrative divisions, where known, are in italics, and place names have the first letter capitalized.

The terminology follows that of Harbach and Knight (1980), with the exception of "tarsal claws" which is retained for "unguis". The venational terms follow that of Belkin (1962).

#### Aedes (Neomelaniconion) mcintoshii new species

Figs. 1A, 1C, 2

This species is named to honor of Dr. Bruce M. McIntosh, Head, Arbovirus Research Unit, National Institute for Virology, Johannesburg, South Africa, in recognition and appreciation of his contributions to our knowledge of the mosquito fauna of South Africa.

Banksinella lineatopennis of Edwards 1915:274 (in part).

Culex luteolateralis of Theobald 1901:71 (in part).

Aedes (Banksinella) lineatopennis of Edwards 1941:202, 400 ( $\sigma^*$ ,  $\Omega^*$ ; P in part).

Aedes (Neomelaniconion) lineatopennis of McIntosh 1971:322 ( $\sigma^*$ ,  $\Omega^*$ , L).

**FEMALE.** Head. Proboscis dark scaled, without pale scales on ventral side, longer than forefemur; maxillary palpus about 0.19 length of proboscis, dark, without white scales; pedicel covered with a few dark scales on inner side; clypeus bare; erect forked scales, numerous, not restricted to occiput, mainly yellow, some dark ones on sides; a frontal tuft of narrow golden yellow scales projecting forward between pedicels;

vertex with median stripe of narrow golden yellow scales, with broad dark scales on each side interrupted by lateral stripe of broad yellow scales, followed ventrally by some broad pale yellow scales. Thorax. Scutum with narrow dark scales, and distinct median patch of narrow golden yellow scales on anterior promontory, a broad lateral longitudinal stripe of narrow golden yellow scales on each side, connected with median golden yellow patch along anterior border of scutum; prescutellar yellow line well developed, usually reaching to posterior 0.33 of scutum; acrostichal, dorsocentral and prescutellar setae present; scutellum with narrow yellow scales on all lobes; antepronotum with a few narrow yellow scales; postpronotum with narrow dark scales and few narrow yellow scales ventrally; paratergite bare; postspiracular area with few narrow yellow scales; hypostigmal area with small patch of narrow yellow scales; subspiracular area with narrow yellow scales; patches of broad pale yellow scales on propleuron, upper and lower portions of mesokatepisternum, and on mesepimeron; lower mesepimeron usually with 2 (1-3) setae; metameron and mesopostnotum bare. Wing (Fig. 1A). With dark scales on all veins except: Sc usually with pale scales on most of its length except for apical area with a few dark scales, sometimes with only a few pale scales scattered, or sometimes without pale scales; R usually with all white scales from base to the base of the branching of Rs, sometimes with a few pale scales extending a short distance onto  $R_1$ ; Rs with all white plume scales, sometimes with mainly white plume scales and a few dark ones scattered;  $R_{2+3}$  with all white plume scales, white plume scales extending onto basal 0.2-0.3 of  $R_2$  and basal 0.4-0.6 of  $R_3$ ; M with all white plume scales, sometimes with mainly white plume scales and a few dark ones scattered, white plume scales extending onto basal 0.3-0.5 of  $M_{1+2}$ ; Cu with all white scales extending onto basal 0.5-0.6 of  $Cu_2$ ; cell  $R_2$  1.9-2.2 length of  $R_{2+3}$ . Halter. With dark scales. Legs. Coxae with patches of pale scales; yellow knee-spot absent on forefemur, present on mid- and hindfemora, those on midfemur much smaller than those on hindfemur; fore- and midfemora anteriorly dark; hindfemur anteriorly with pale scales on basal 0.5; all tibiae anteriorly dark; all tarsi dark, fore- and midlegs with tarsal claws equal, all toothed; hindleg with tarsal claws equal, both simple. Abdomen. Tergum I with pale scales on laterotergite, sometimes with a basomedian pale spot; terga II-VII each with a basal pale band and basolateral pale spots which do not connect with the basal pale band; terga II-VI each with apicolateral pale spots, those on terga V, VI tend to extend anteriorly along the lateral margins; tergum VII sometimes with pale scales along the lateral margin; sterna II-VI each with basolateral and apicolateral pale spots; segment VIII completely retracted. Genitalia. Apical margin of sternum VIII with a median notch and a conspicuous rounded lateral lobe; insula longer than wide, with minute setae and with 2 larger setae on apical 0.25; apical margin of tergum IX with a well developed lateral lobe, with 7-9 setae; apical margin of postgenital plate with deep median notch; cercus long and narrow; 3 spermathecae, one larger than the other 2.

**MALE.** Essentially as in the female, differing in the following sexual characters: Head. Maxillary palpus, longer than proboscis, about 1.3-1.4

length of proboscis; palpomere 5 absent; palpomere 4 upturned with numerous long setae arising laterally and ventrally; apical 0.3 of palpomere 3 with similar long setae arising latero-ventrally; antenna plumose, shorter than proboscis. Thorax. Lower mesepimeron without setae. Wing. Cell R<sub>2</sub> about 1.0-1.2 length of R<sub>2+3</sub>. Legs. fore- and midlegs with tarsal claws unequal, both toothed. Genitalia (Figs. 1C, 2). Gonocoxite elongate, narrow towards apex, broadened basally, with setae scattered on dorsal surface, with distinct large patch of about 4-6 rows of setae on dorsomesal surface, and a number of stout, long, curved setae along dorsomesal margin of swollen basal portion, with a double row of stout, short, pointed spines, 8-10 in number along dorsomesal margin of narrow portion, but not originating beyond the insertion of gonostylus, with a number of long, curved setae on the apical part of gonocoxite; basal dorsomesal lobe a short process bearing 2 short stout spines and 1 seta on apicodorsal area, and with 1 seta on apicoventral and 3 setae on basoventral areas; gonostylus inserted subapically, short, expanded on the inner side near middle, with a long, straight, rather slender claw at apex; aedeagus with lateral plates, with 2,3 stout, apical curved teeth on each side; paraproct without apical teeth, cercal setae absent; apical margin of tergum IX slightly concave medially, with 6 (5-7) setae on each side; sternum IX with 2,3 setae.

PUPA and LARVA. Not described. Only 3 associated larval and pupal skins from type series are available, and these are in very poor condition.

TYPE DATA. Holotype male (MEP Acc. 506, Op/75,C4/-) with genitalia on slide (85/37), Onderstepoort, Transvaal, SOUTH AFRICA, Jan.-Apr. 1975, J. Muspratt [USNM]. Allotype female (MEP Acc. 506, Op/75,C4/-), same data as holotype [USNM]. Paratypes: 2 males, 5 females as follows, (MEP Acc. 506, Op/75,C4/-): 2 males with genitalia on slides (83/47, 85/38) and 1 female with genitalia on slide (85/66), same data as holotype [USNM]; 1 female (MEP Acc. 506, Op/75,C4/VI) with associated larval and pupal skins on slide, collected as a larva from stream pool, same data as holotype [USNM]; 2 females (MEP Acc. 673, 0002/77/1, 0002/77/2) with associated larval and pupal skins on slides, with tarsal claws mounted on slides (85/61, 85/62), and 1 female (MEP Acc. 673, 0002/77/3) with associated pupal skin on slide, with tarsal claws mounted on slide (85/63), collected as larvae from a large ground pool, same data as holotype except 20 Dec. 1976 [USNM].

MATERIAL EXAMINED. 49 specimens: 36 adults (12 males, 24 females), 12 male genitalia, 2 female genitalia, 6 female tarsal claws; 15 individual rearings (8 larval, 15 pupal).

SOUTH AFRICA. Transvaal: Onderstepoort ( $25^{\circ} 26' S$ ,  $27^{\circ} 01' E$ ), Jan.-Apr. 1975, J. Muspratt, 3♂, 2♀, 3♂ gen. 1♀ gen (MEP Acc. 506, Op/75,C4/-, 83/47, 85/37, 85/38, 85/66), 1 lp♀ (Op/75,C4/V1) [USNM]; same data except 20 Dec. 1976, 2 lp♀ (MEP Acc. 673, 0002/77/1, 0002/77/2), 2♀ claws (85/61, 85/62), 1 p♀ (MEP Acc. 673, 0002/77/3), 1♀ claws (85/63) [USNM]; Newington ( $24^{\circ} 52' S$ ,  $31^{\circ} 24' E$ ), Nov. 1969, B.M. McIntosh, 1♂, 1♂

gen (M794-4, T73.10 Term.), 1♀, 1♀ gen (M-794-26, T73.9 Term.), 3♀ (M794-4, 15, 26) [USNM]; Lake Chrissie ( $26^{\circ} 20' S$ ,  $30^{\circ} 13' E$ ), Feb. 1970, B.M. McIntosh, 1♀, 1♀ claws (M836-3, 85/64) [USNM]. Natal: Durban Coast ( $29^{\circ} 52' S$ ,  $31^{\circ} 03' E$ ), 2 Feb. 1976, J. Muspratt, 1 lpo♂, 1♂ gen (MEP Acc. 602, 0037/1,75-76, 85/43) [USNM]; same data except 27 Feb. 1976, 1 lpo♂, 1♂ gen (MEP Acc. 602, 0038/2,75-76, 83/48), 2 lp♀ (MEP Acc. 602, 0038/1,75-76, 0038/3,75-76), 1♀ (MEP Acc. 602, 0038/-,75-76) [USNM]. Orange Free State: Bethulie ( $30^{\circ} 30' S$ ,  $25^{\circ} 58' E$ ), Mar. 1969, B.M. McIntosh, 1♀, 1♀ claws (M704.Q-14, 85/65) [USNM].

ZIMBABWE. Mashonaland South Province: Salisbury ( $17^{\circ} 50' S$ ,  $31^{\circ} 03' E$ ), Mar. 1900, G.A.K. Marshall, 2♀ [USNM]; Pearson ( $17^{\circ} 38' S$ ,  $30^{\circ} 57' E$ ), May 1969, B.M. McIntosh, 1♀ (M772) [USNM].

KENYA. 1982, USAMRU-K TEAM, 1♂, 1♂ gen (MEP Acc. 1014, KE 207-109, 85/42) [USNM]. Central Region: Kitambu, Ruiru ( $1^{\circ} 12' S$ ,  $37^{\circ} 07' E$ ), 1982, USAMRU-K TEAM, 4 Po♂, 2 p♀, 4♂ gen (MEP Acc. 1014, KE209-102, 103, 106, 107, 101, 108, 85/33, 83/41, 85/41, 85/34), 1♂, 1♂ gen (MEP Acc. 1014, KE209-110, 85/35) [USNM]; same data, 2♀ (MEP Acc. 1014, KE 210-106, 107) [USNM]. Nairobi Area: 1982, USAMRU-K TEAM, 1 lp♀ (MEP Acc. 1014, KE-170-13) [USNM]; Nairobi Arboretum Forest Reserve ( $1^{\circ} 17' S$ ,  $36^{\circ} 50' E$ ), 14 Apr. 1983, Y.M. Huang, 1♀ (MEP Acc. 1035, #215) [USNM].

DISTRIBUTION (Map 1). Aedes mcintoshi is presently known from southern (South Africa, Zimbabwe) and eastern (Kenya) Africa. Other records of so-called "lineatopennis" from the Afrotropical Region will require confirmation owing to probable confusion with Ae. circumluteolus, Ae. luteolateralis and Ae. unidentatus.

TAXONOMIC DISCUSSION. Aedes mcintoshi is a member of the subgenus Neomelaniconion Newstead, because it possesses the following characters: decumbent scales of the vertex largely narrow; erect, forked scales numerous, not restricted to occiput; male maxillary palpus longer than proboscis, palpomere 5 absent, palpomere 4 upturned with numerous long setae; acrostichal and dorsocentral setae present; paratergite bare; scutellum with all scales narrow.

The adult males and females of Ae. mcintoshi are not only morphologically very similar to those of lineatopennis but also to those of African species of the subgenus Neomelaniconion: circumluteolus (Theobald), luridus McIntosh, luteolateralis (Theobald), and unidentatus McIntosh. These species form a unique group, the lineatopennis group, and share the following combination of characters: (1) scutum with broad lateral longitudinal stripes of yellow scales, (2) C, R<sub>4+5</sub>, and 1A veins with all dark scales, (3) R vein with all white scales at least from base to the base of Rs, and (4) the terga with basal bands. However, mcintoshi differs from all congeners of this species group except lineatopennis and circumluteolus by the hind tarsal claws, which are equal and simple.

The adults of Ae. mcintoshi are similar to those of lineatopennis and

circumluteolus. However, they can be distinguished easily from those of lineatopennis by: (1) R vein with all white scales at most on basal 0.3, (2) Sc vein with at least a few dark scales, and (3) female cell  $R_2$  1.9-2.2 length of vein  $R_{2+3}$ . In lineatopennis, the R vein has all white scales at least on basal 0.5, the Sc vein with all white scales, and the female cell  $R_2$  is 1.5-1.9 length of vein  $R_{2+3}$ . Aedes mcintoshi and circumluteolus are similar in having the R vein with all white scales at most on basal 0.3 and the Sc vein with at least a few dark scales. It differs from circumluteolus by: (1) Rs,  $R_{2+3}$  and M veins with plume scales all white, sometimes mainly white, and (2)  $R_2$ ,  $R_3$  and  $M_{1+2}$  veins with some white plume scales. In circumluteolus, the plume scales on Rs,  $R_{2+3}$ ,  $R_2$ ,  $R_3$ , M and  $M_{1+2}$  veins are all to mostly dark, or at most with only a few pale scales.

The male genitalia of Ae. mcintoshi are also very similar to those of lineatopennis and circumluteolus and have the gonocoxite elongate, narrow towards apex, broadened basally, bearing some stout, long, curved setae along dorsomesal margin of swollen basal portion, with a double row of stout, short, pointed spines along dorsomesal margin of narrow portion, with some long, curved setae on the apical part of gonocoxite; basal dorsomesal lobe short process, bearing stout spines and setae; gonostylus inserted subapically, short, expanded on inner side near middle, with a long, straight, rather slender claw at apex. The male genitalia of Ae. mcintoshi differ from those of lineatopennis and circumluteolus by the gonocoxite, which has a distinct large patch of 4-6 rows of setae on the dorsomesal surface of the swollen basal portion and which bears 8-10 stout, short, pointed spines along dorsomesal margin of narrow portion. The short spines do not originate beyond the insertion of the gonostylus (Fig. 1C). The genitalia of lineatopennis have a gonocoxite with a distinct, small patch of 2,3 rows of setae on the dorsomesal surface of the swollen basal portion, and the stout, short, pointed spines of the gonocoxite, usually 12 (10-16) in number, are interspersed along dorsomesal margin of narrow portion, with some originating well beyond the insertion of the gonostylus (Fig. 1D).

REMARKS. Use of the name Ae. lineatopennis has caused considerable confusion in Africa and has often been misused. For example, among specimens in the USNM collections, I have found at least 4 species that were misidentified as lineatopennis. In this paper the distribution of lineatopennis currently is restricted to the Oriental Region (the Philippines, Viet Nam, Cambodia, Thailand, Malaya, Sumatera, Java, Sri Lanka, Pakistan and India). Although no specimens of lineatopennis were found among the African specimens I examined, it would still be premature to completely discount its occurrence in the Afrotropical Region. More specimens from other areas need to be collected and studied. However, the taxonomic status of the so-called "lineatopennis" (see literature cited) from Africa is not conspecific with topotypic material from the Philippines.

BIONOMICS. The immature stages of Ae. mcintoshi have been collected in a stream pool and in a large ground pool in Onderstepoort, Transvaal,

South Africa, and in a pond in Durban Coast, Natal, South Africa. In Kenya, the pupae of this species were collected in a ground pool and in a medium-sized flooded pool in Ruiru, Kitambu.

The female specimen of Ae. mcintoshii from Nairobi Arboretum Forest Reserve, Nairobi Area, Kenya, was taken landing-biting on man. McIntosh (1971:325) reported that in South Africa, Ae. mcintoshii (as lineatopennis) readily bites man and larger domestic animals.

Aedes mcintoshii has been collected in association with Ae. unidentatus from Onderstepoort, Transvaal, and in association with Ae. luteolateralis from Durban Coast, Natal, South Africa; it has also been found in association with Ae. circumluteolus from Ruiru, Central Region, Kenya.

MEDICAL IMPORTANCE. McIntosh (1971:325) stated that 2 strains of Rift Valley Fever (RVF) virus, 17 of Wesselsbron (WSL) and 2 of Middelburg (MID) were isolated from Ae. mcintoshii (as lineatopennis) from collections made in May, 1969, during an extensive epizootic of Rift Valley Fever virus in cattle in Rhodesia, and that this species was the main vector during this outbreak. Aedes mcintoshii (as lineatopennis) has also been incriminated as vector of Rift Valley Fever by McIntosh (1972) in Zimbabwe, by Davies and Highton (1980) in Kenya, and by McIntosh et al. (1980) in South Africa.

#### Aedes (Neomelaniconion) lineatopennis (Ludlow)

Figs. 1B, 1D, 3

Taeniorhynchus lineatopennis Ludlow 1905:133 (♀).

Aedes (Banksinella) lineatopennis of Knight and Hull 1953:468 (♂\*, ♀, L\*; Lectotype female designated).

Aedes (Neomelaniconion) lineatopennis of Mattingly 1961:49 (♂\*, ♀\*, P\*, L\*).

TYPE: Female, with hand printed label data as follows: Taeniorhynchus lineatopennis Ludlow, Camp Gregg, Angeles, Pampanga, [Luzon], P. I., Sept./ Type No. 27794, U.S.N.M./ Lectotype, Knight & Hull, 1953.

The descriptions below are based on the lectotype and the topotypic specimens from Luzon, the Philippines in the United States National Museum.

FEMALE. Wing (Fig. 1B). With dark scales on all veins except: Sc with all pale scales; R with all white scales from base reaching beyond the base of the branching of Rs and extending onto basal 0.3-0.4 of R<sub>1</sub>; Rs without white plume scales, sometimes with a few scattered white plume scales; R<sub>2+3</sub> with all white plume scales, white plume scales extending onto basal 0.2-0.3 of R<sub>2</sub> and basal 0.4-0.6 of R<sub>3</sub>; M from base to the level of m-cu without white plume scales, or sometimes with a few scattered white plume scales, with all white plume scales from the level of m-cu, extending

onto basal 0.3-0.5 of  $M_{1+2}$ ; Cu with all white scales extending onto basal 0.4-0.6 of  $Cu_2$ ; cell  $R_2$  1.5-1.9 length of  $R_{2+3}$ .

MALE. Genitalia (Figs. 1D, 3). Gonocoxite elongate, narrow towards apex, broadened basally, with setae scattered on dorsal surface, with distinct small patch of about 2,3 rows of setae on dorsomesal surface, and some stout, long, curved setae along dorsomesal margin of swollen basal portion, with a double row of usually 12 (10-16) stout, short, pointed spines interspersed along dorsomesal margin of narrow portion, with some originating beyond the insertion of gonostylus, with a number of long, curved setae on the apical part of gonocoxite; basal dorsomesal lobe a short process bearing 2 short stout spines and 1 seta on apicodorsal area, and with 1 seta on apicoventral and 2,3 setae on basoventral areas; gonostylus inserted subapically, short, expanded on the inner side near middle, with a long, straight, rather slender claw at apex; aedeagus with lateral plates, with 3-4 stout, apical curved teeth on each side; paraproct without apical teeth, cercal setae absent; apical margin of tergum IX concave medially with 3-6 setae on each side; sternum IX with 2,3 setae.

MATERIAL EXAMINED. 71 specimens: 43 adults (23 males, 20 females), 20 male genitalia, 4 female genitalia, 2 female claws; 16 individual rearings (15 l, 16 p) from the Philippines.

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Map 1

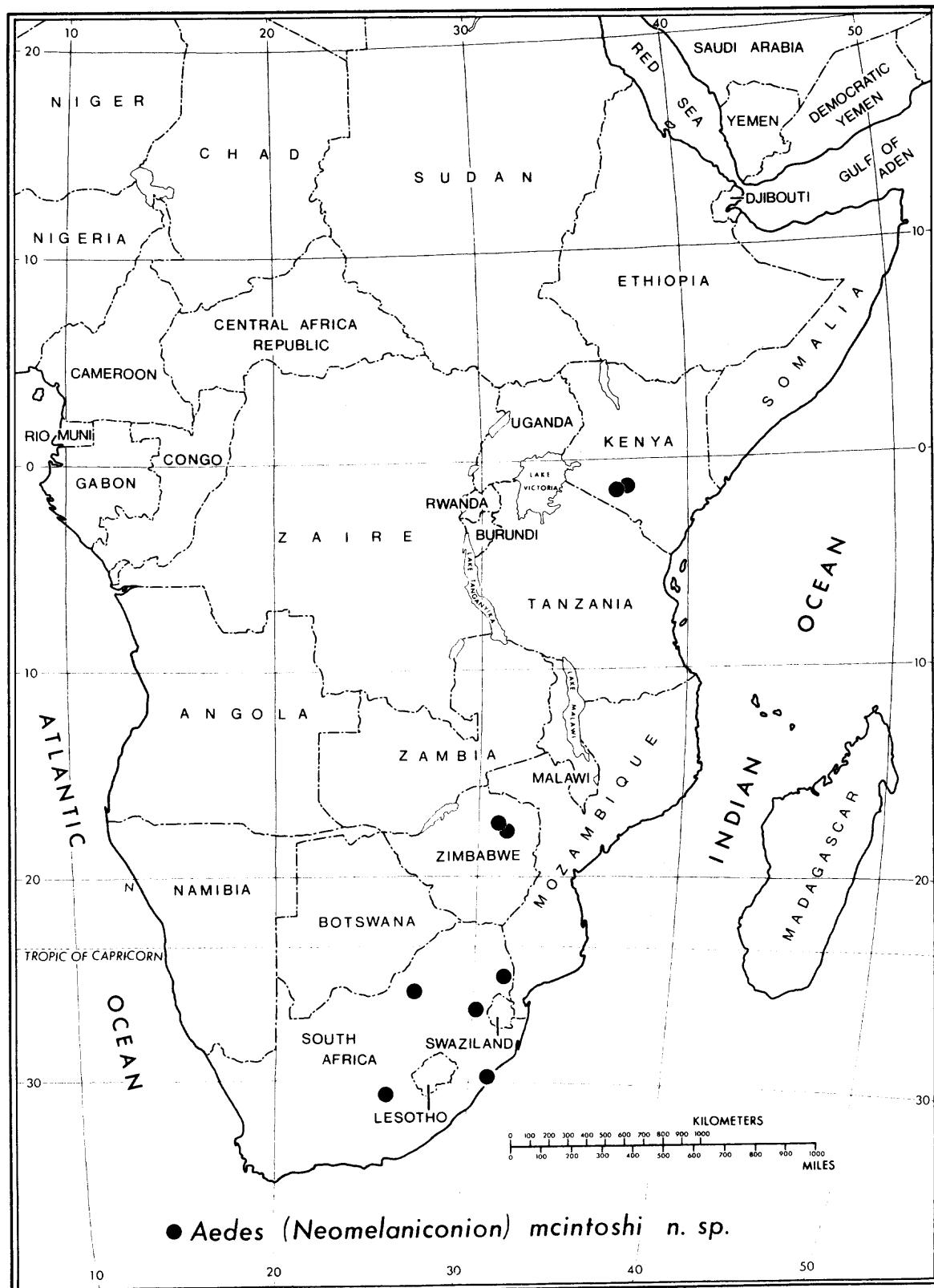


Fig. 1

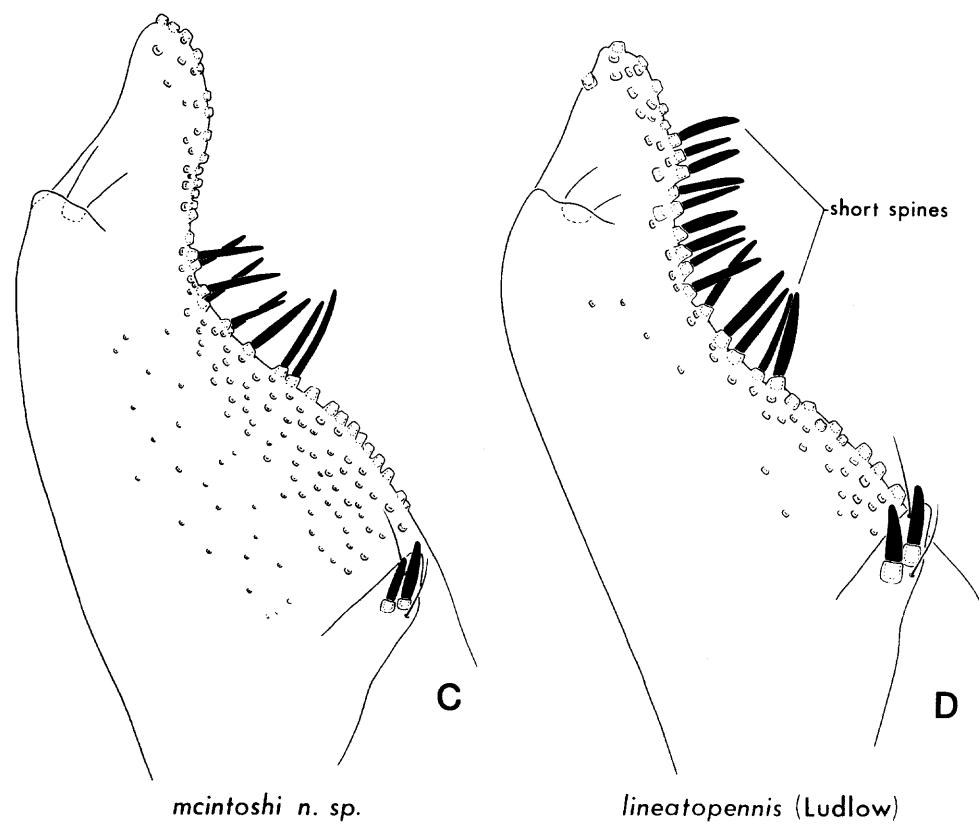
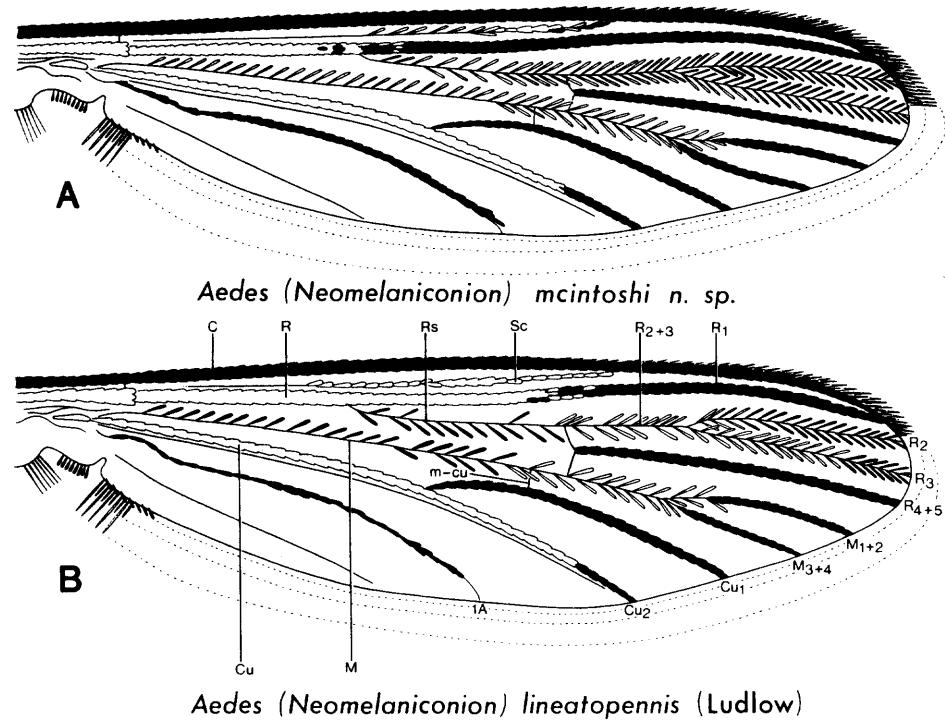
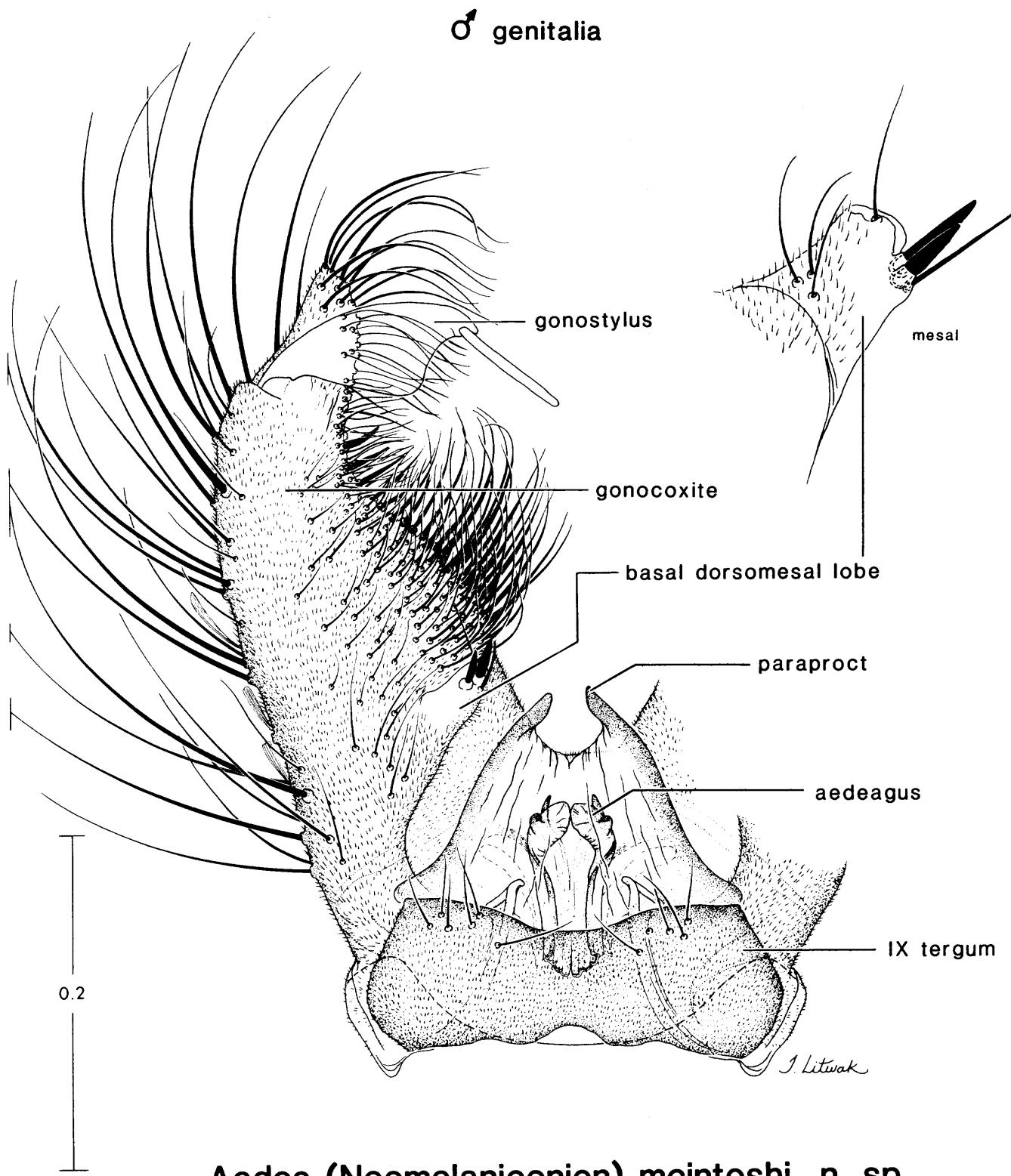
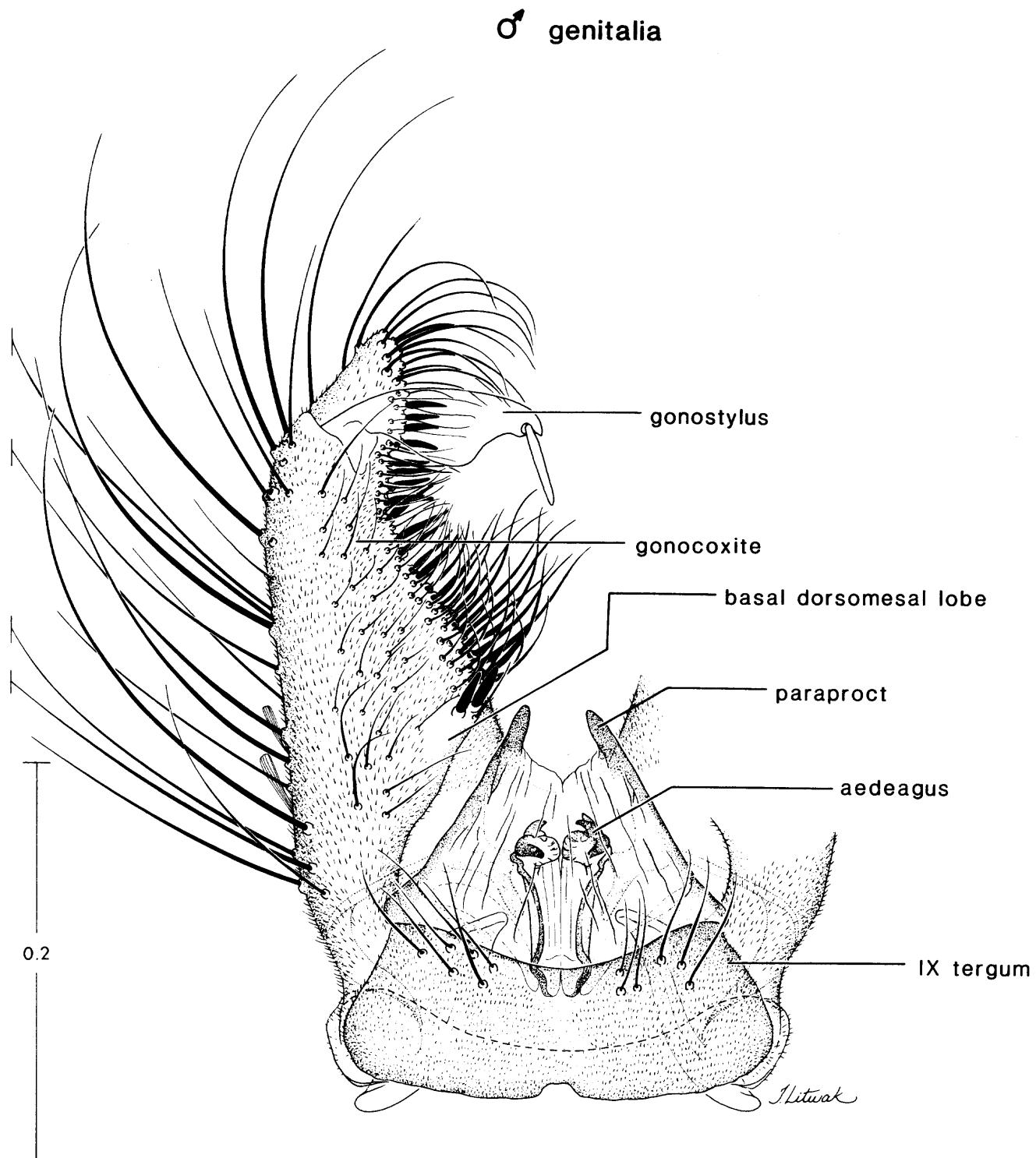


Fig. 2



Aedes (Neomelaniconion) mcintoshi n. sp.

Fig. 3



Aedes (Neomelaniconion) lineatopennis (Ludlow)